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Chemical and Physical Properties of Hydrogen Peroxide

Density - 1.46 g/ml
 Boiling Point - 152 C
 Critical Temperature - 457 C
 Critical Pressure - 214 atm
 Molar Enthalpy of Vaporization - 51 kJ/mole
 Solubility Parameter - 46 MPa^{1/2}

FIG. 1

Chemical and Physical Properties of Carbon Dioxide

Density - 0.4 -0.9 g/ml
 Critical Temperature - 31 C
 Critical Pressure - 73 atm
 Molar Enthalpy of Vaporization - 2.5 kJ/mole
 Solubility Parameter - 14-22 MPa^{1/2}

CO ₂ Permeability with HDPE Film		CO ₂ compared to EtO		Sporicidal Activity
He	CO ₂	EtO	CO ₂	
0.005	2	S 22	22	EtO epoxide group CO ₂ oxy acid group (H ₂ O ₂)
360	16	MW 44	44	
1.9	<div>31</div> 16x more permeable than He	Solubility Parameter - MPa ^{1/2}		
Permeability = Diffusivity x Solubility		Molecular Weight g/mole		

FIG. 2

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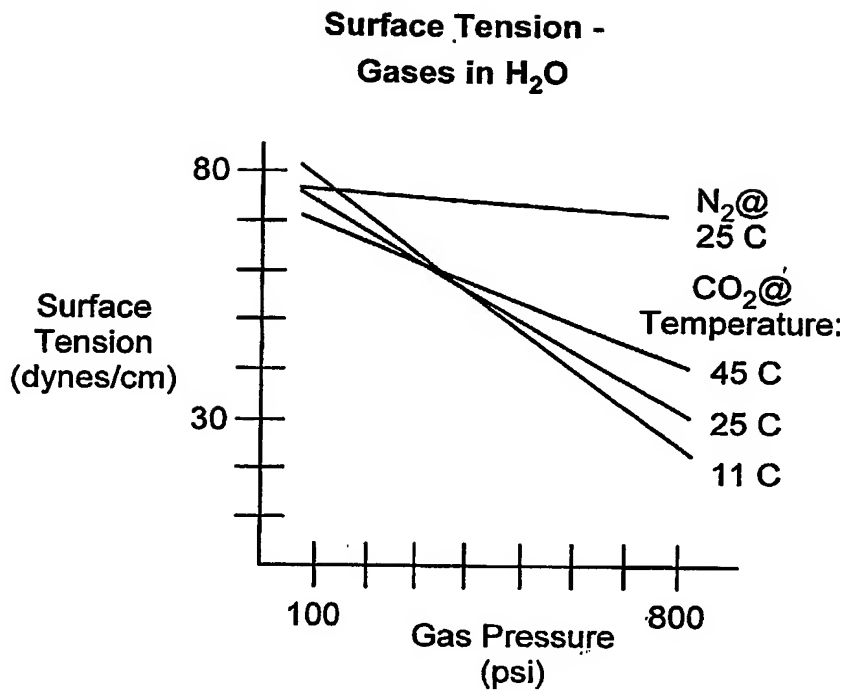


FIG. 3

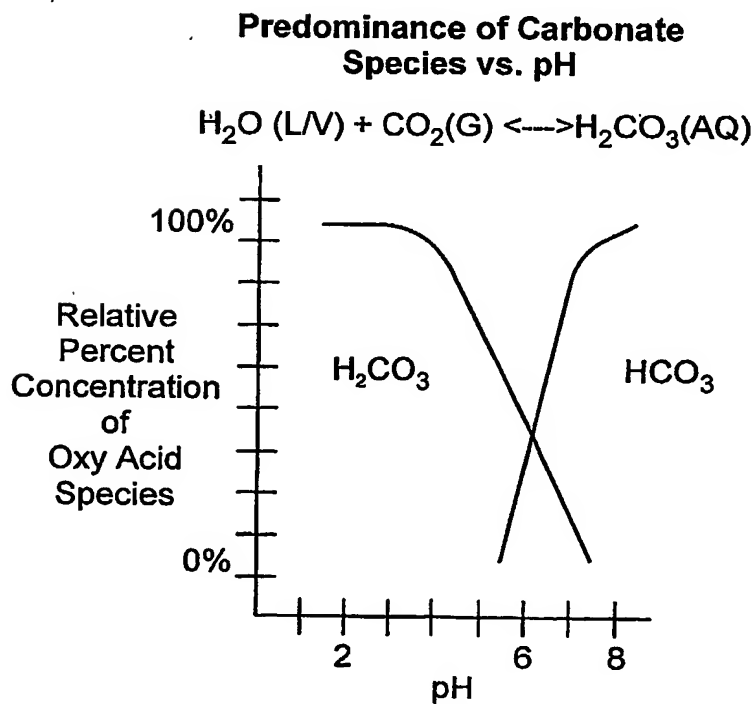
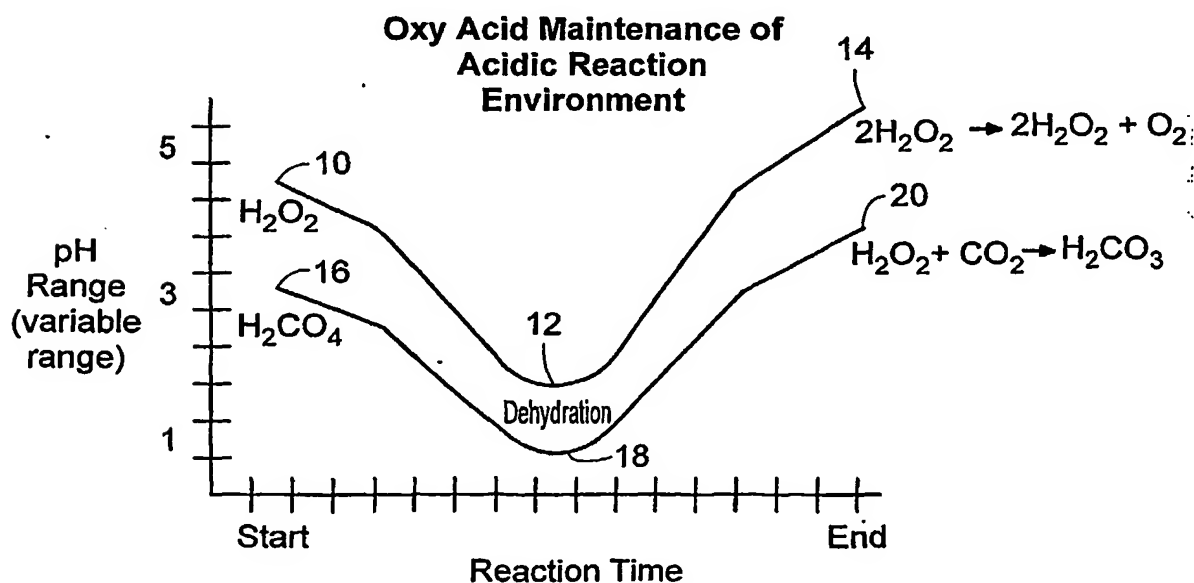
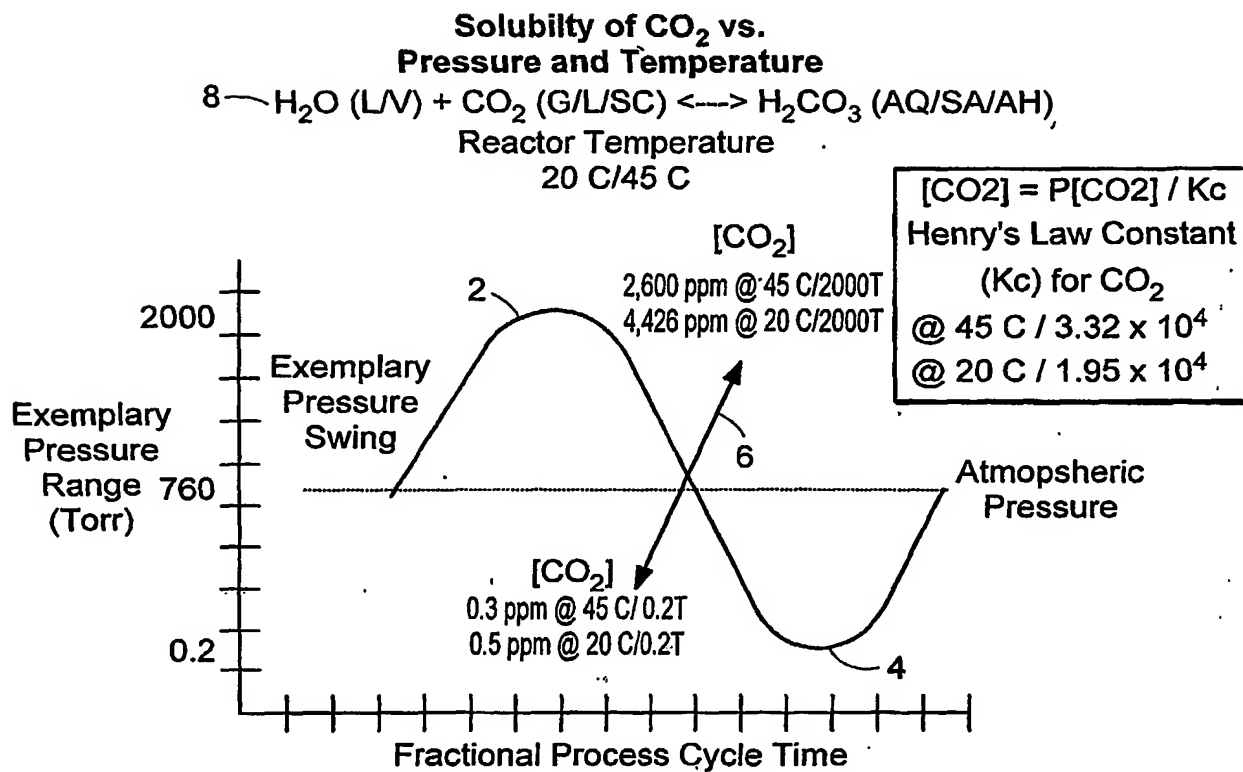


FIG. 4

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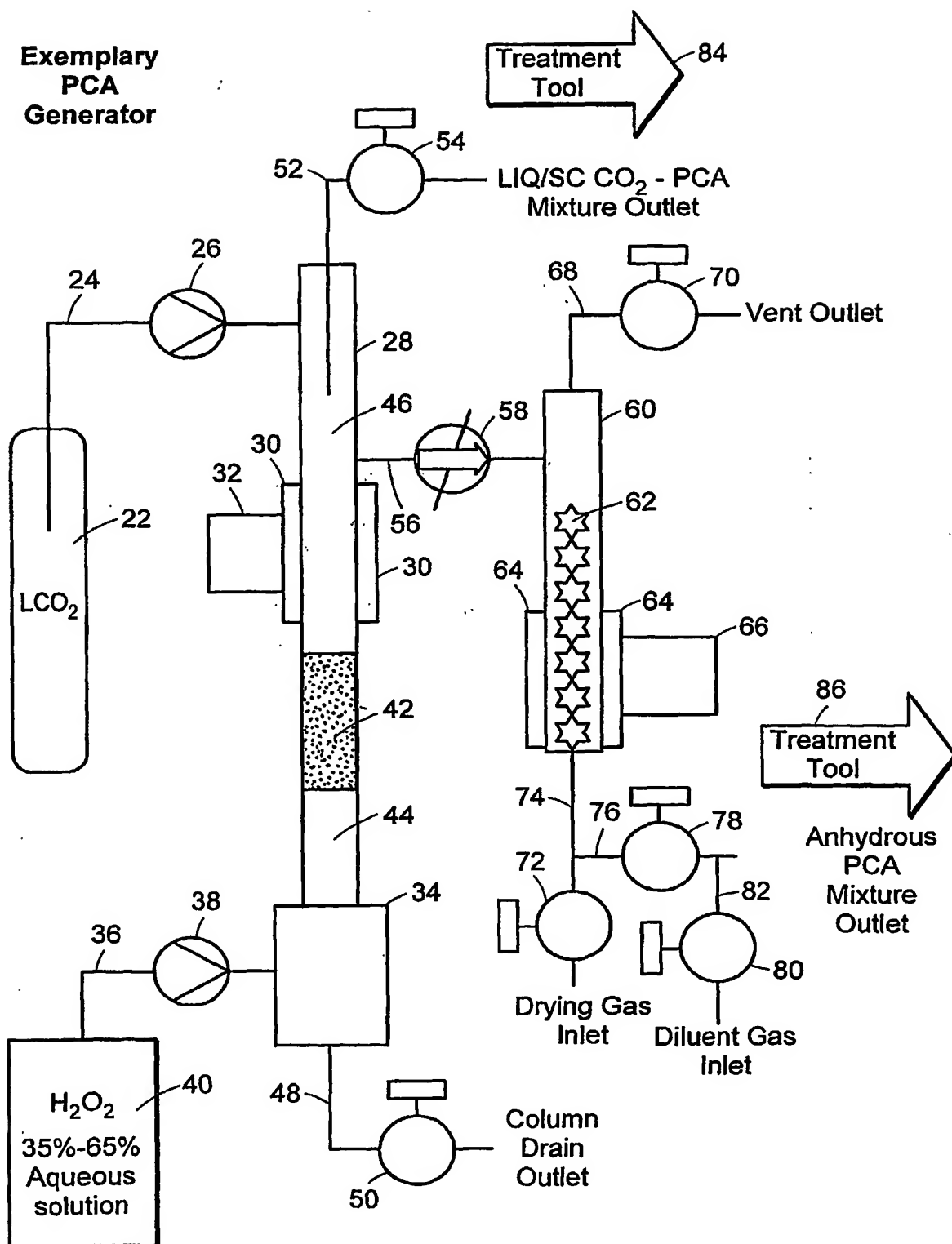
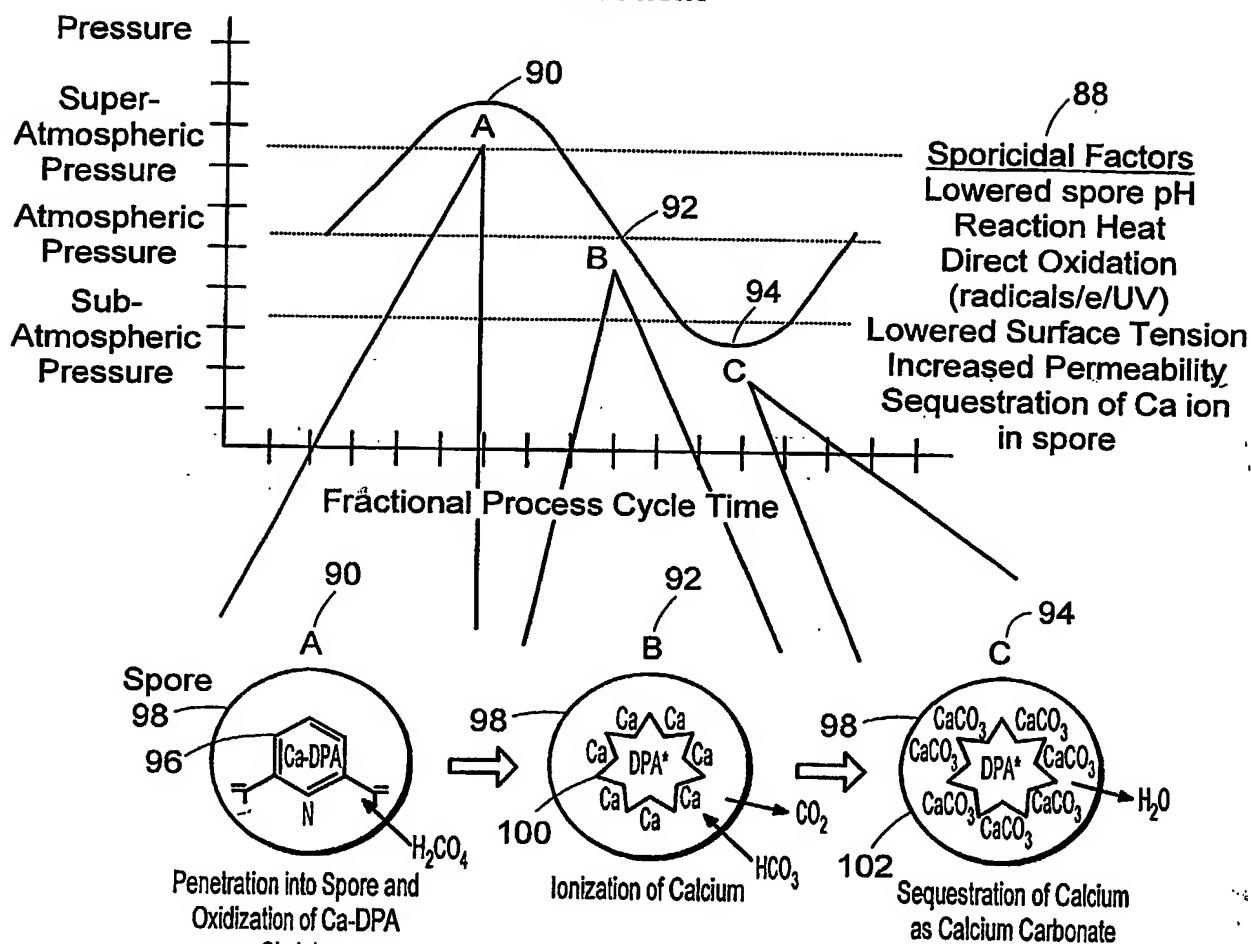


FIG. 7

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Possible Mechanisms for Sporicidal Action of Percarbonic Acid Treatment



Possible reaction Schemes for Percarbonate (PCA) Oxidation and Sequestration of Spore Complex Ca-DPA

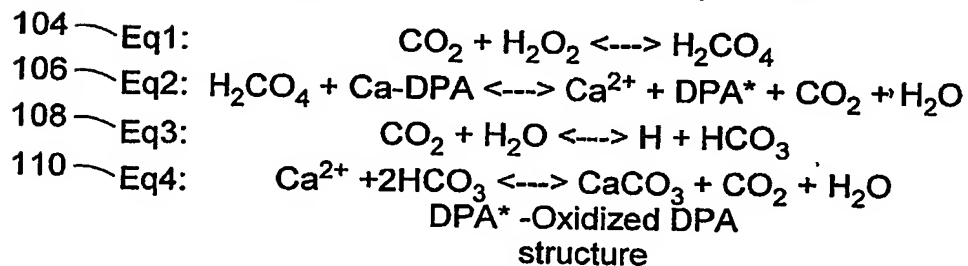


FIG. 8

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Plasma-Photochemical Activation

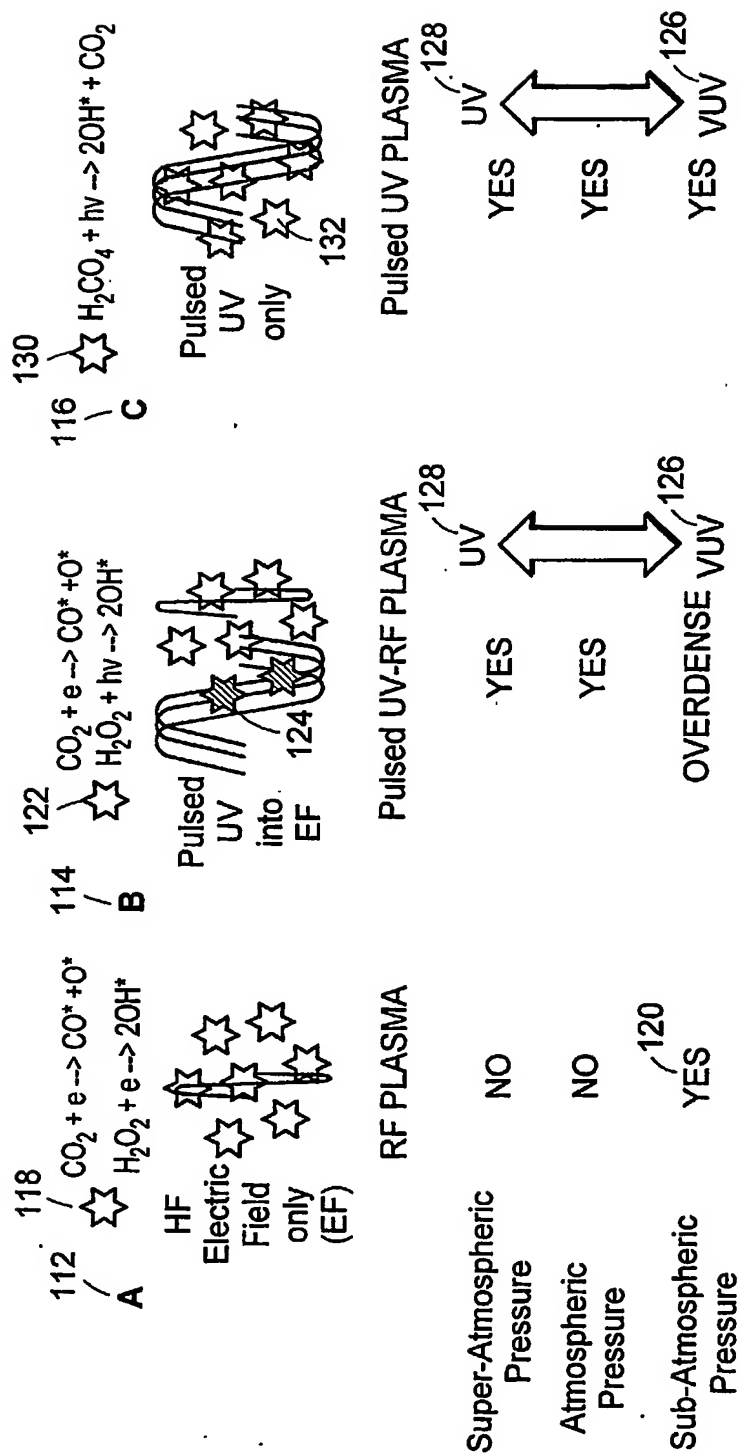
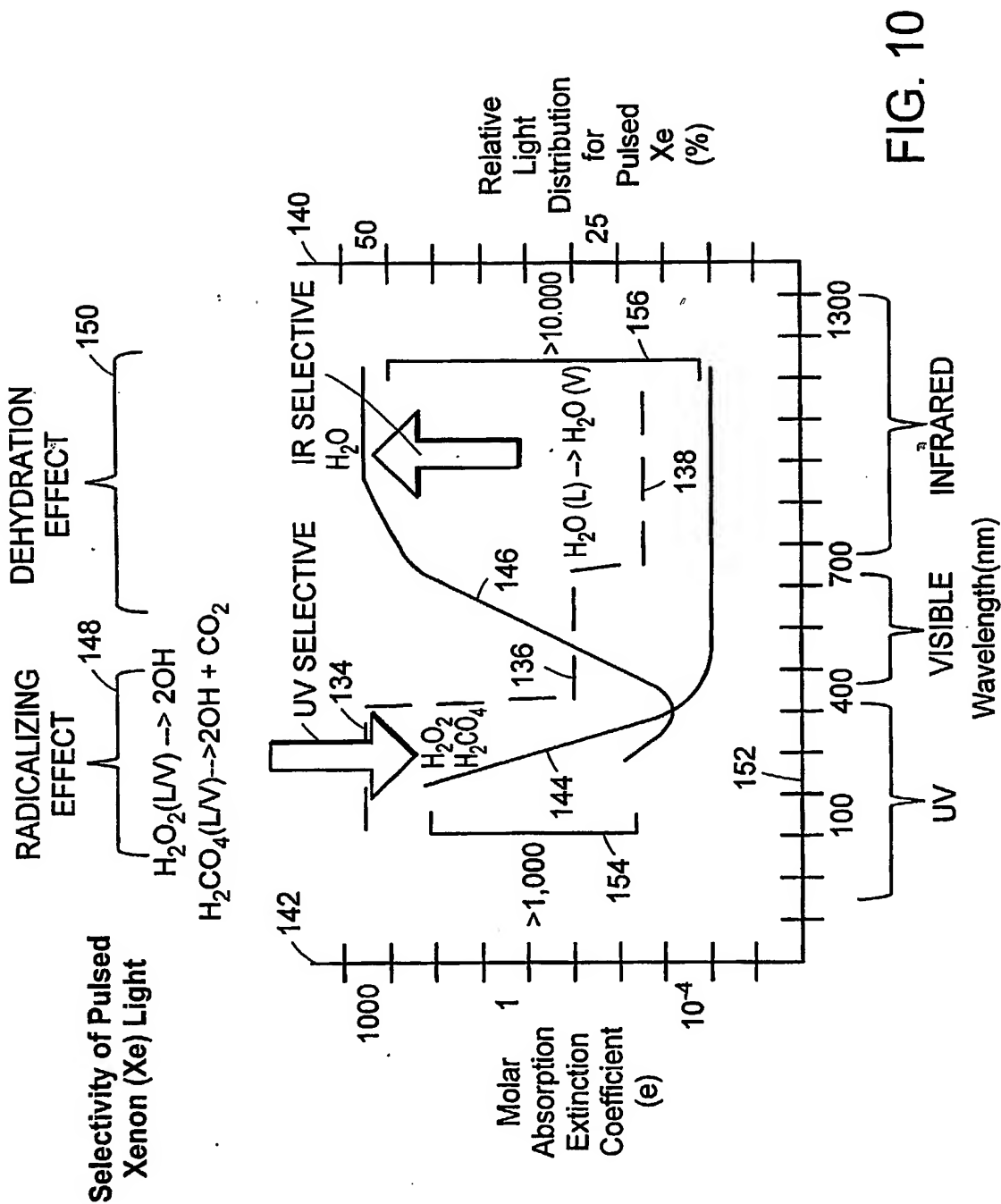


FIG. 9

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Oxy Acid Complexes and UV-VIS Absorption

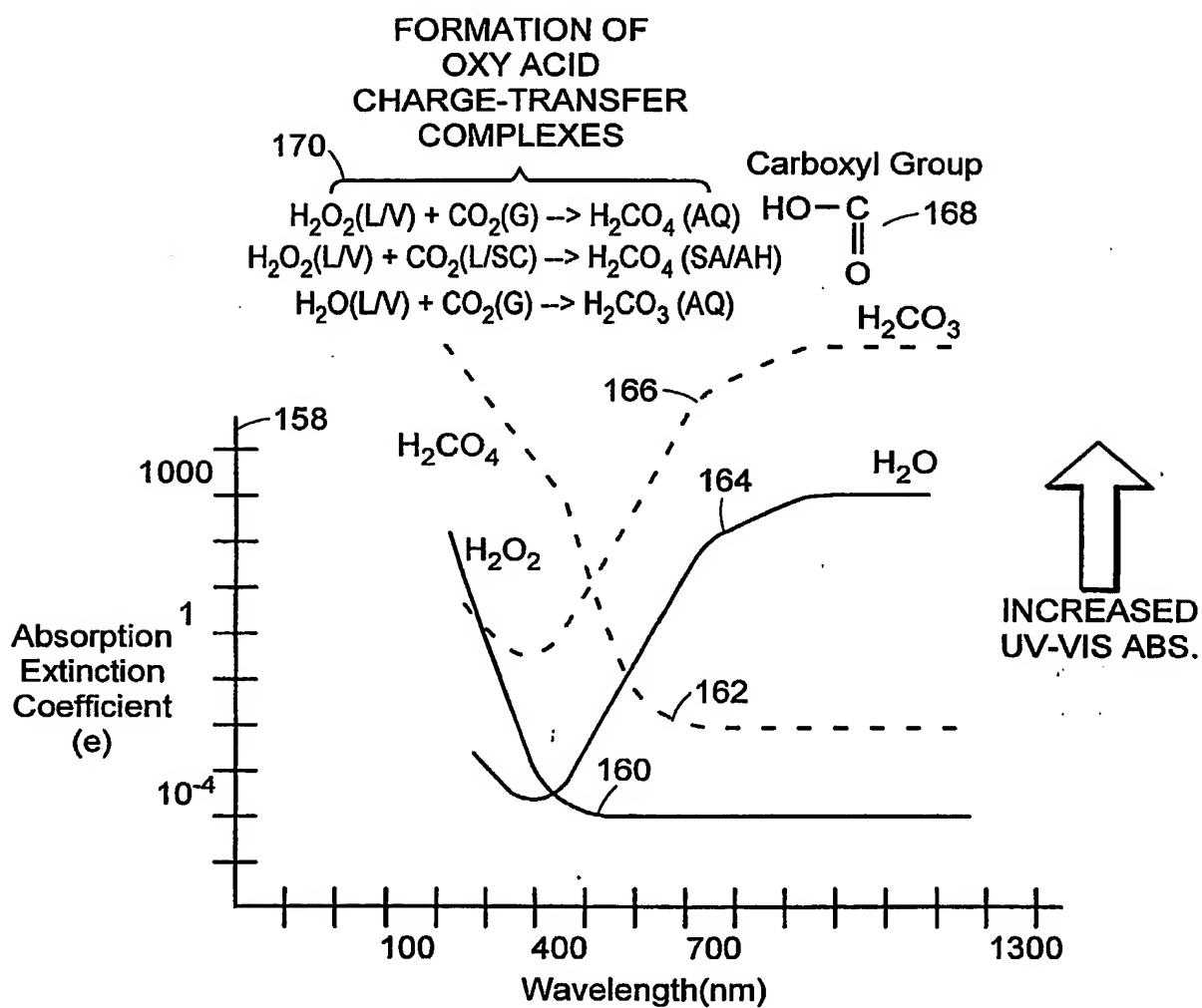


FIG. 11

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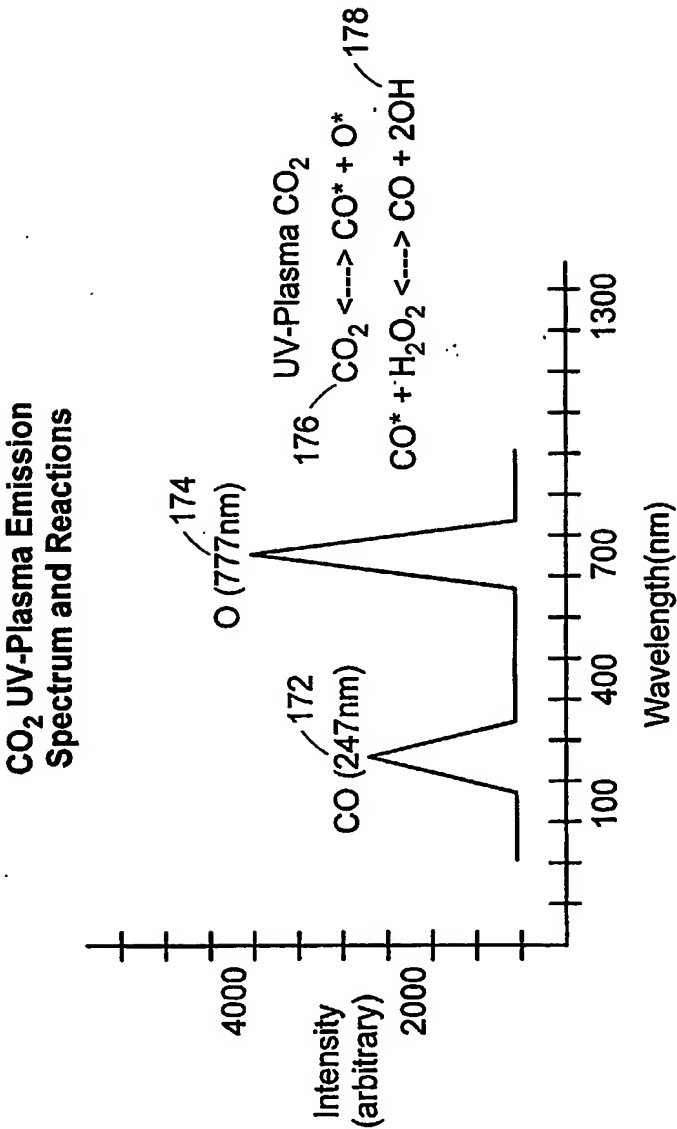


FIG. 12

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Centrifugal and Coriolis Forces

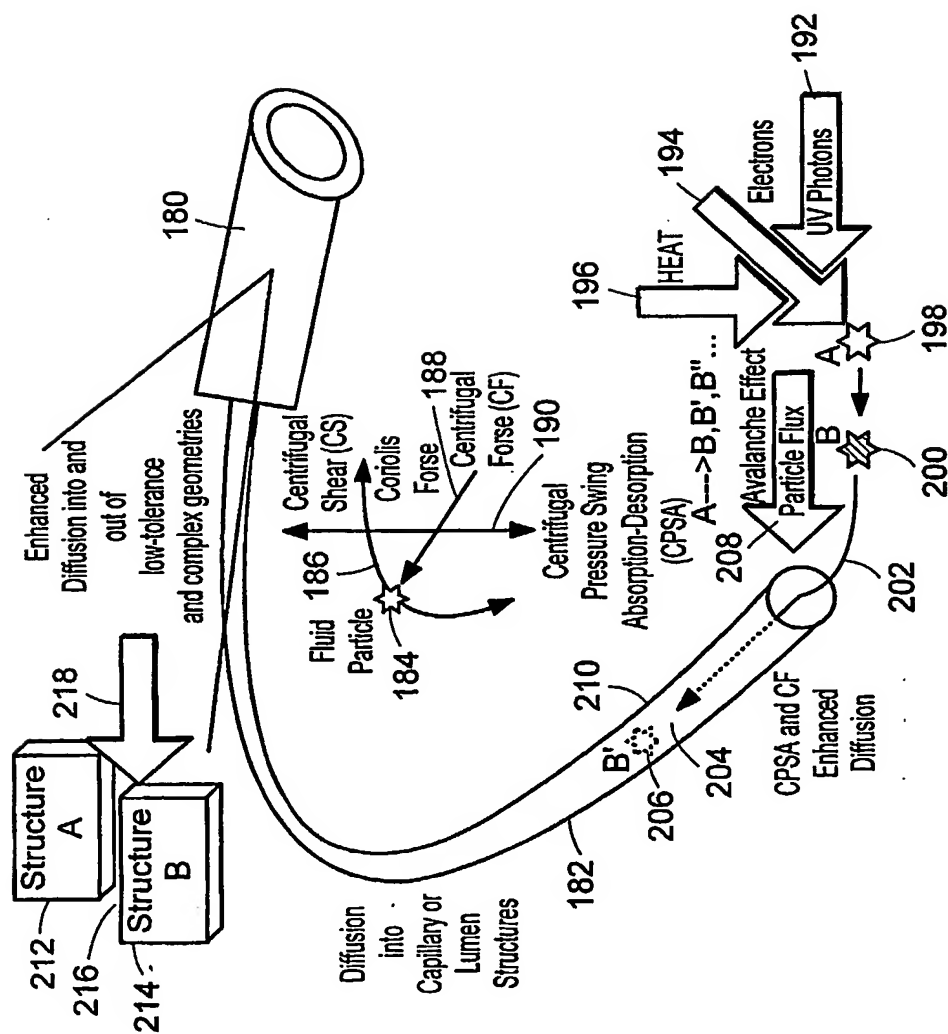


FIG. 13

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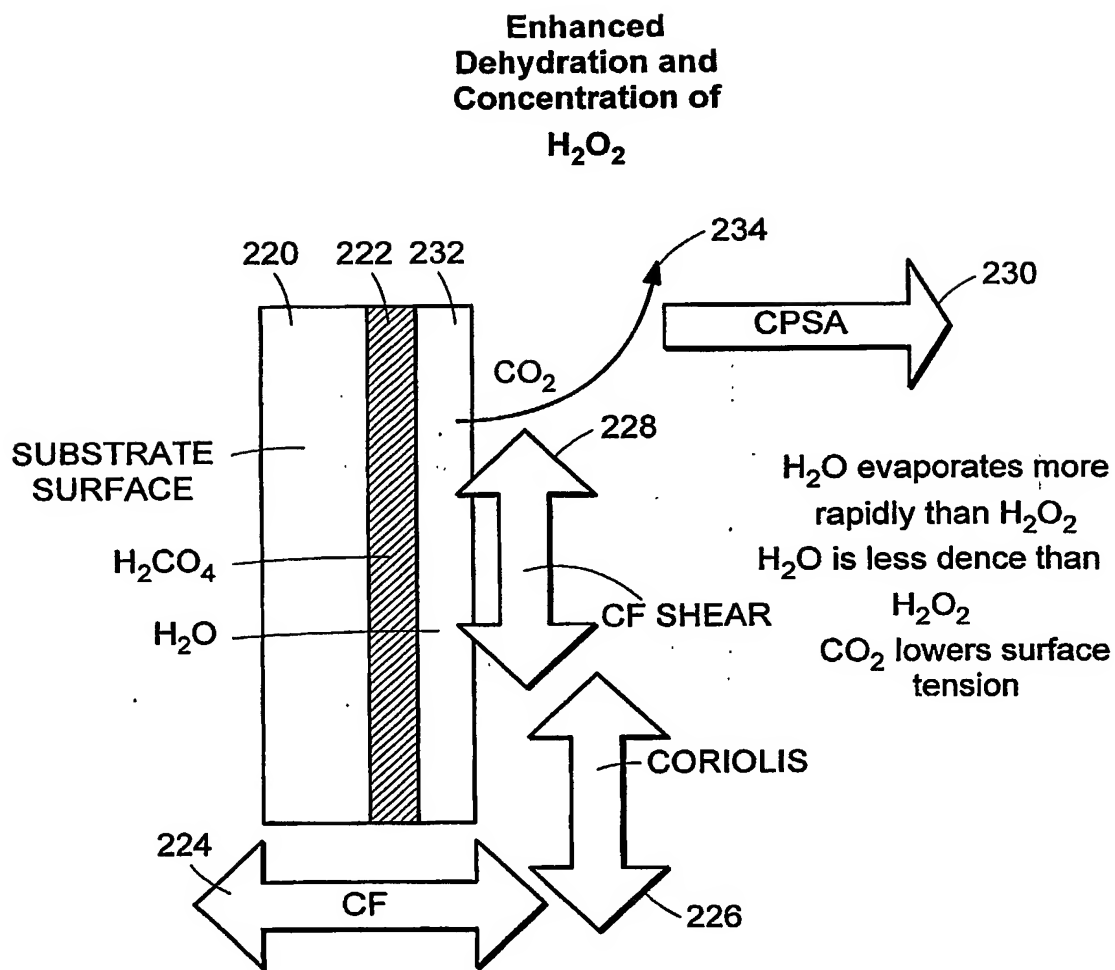


FIG. 14

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Exemplary CPISA Cycle with
PCA

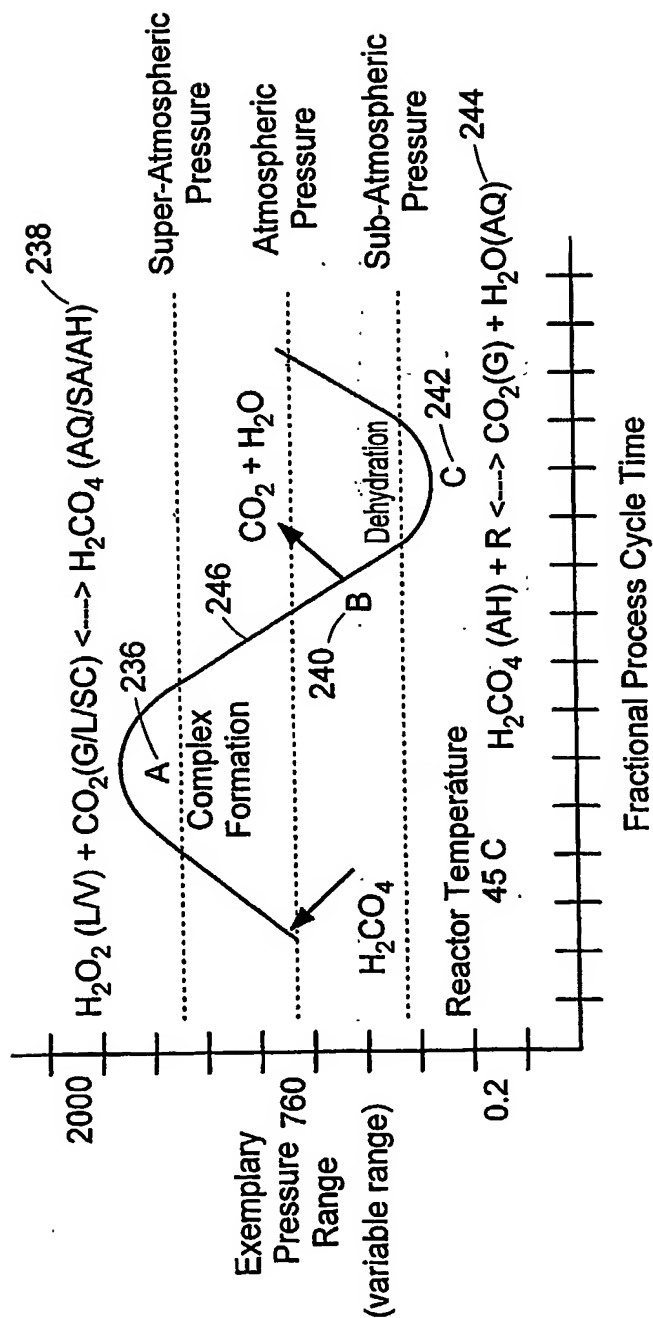


FIG. 15

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Exemplary
Centrifugal
UV-Plasma
Treatment
Apparatus
(Vertical Basket)

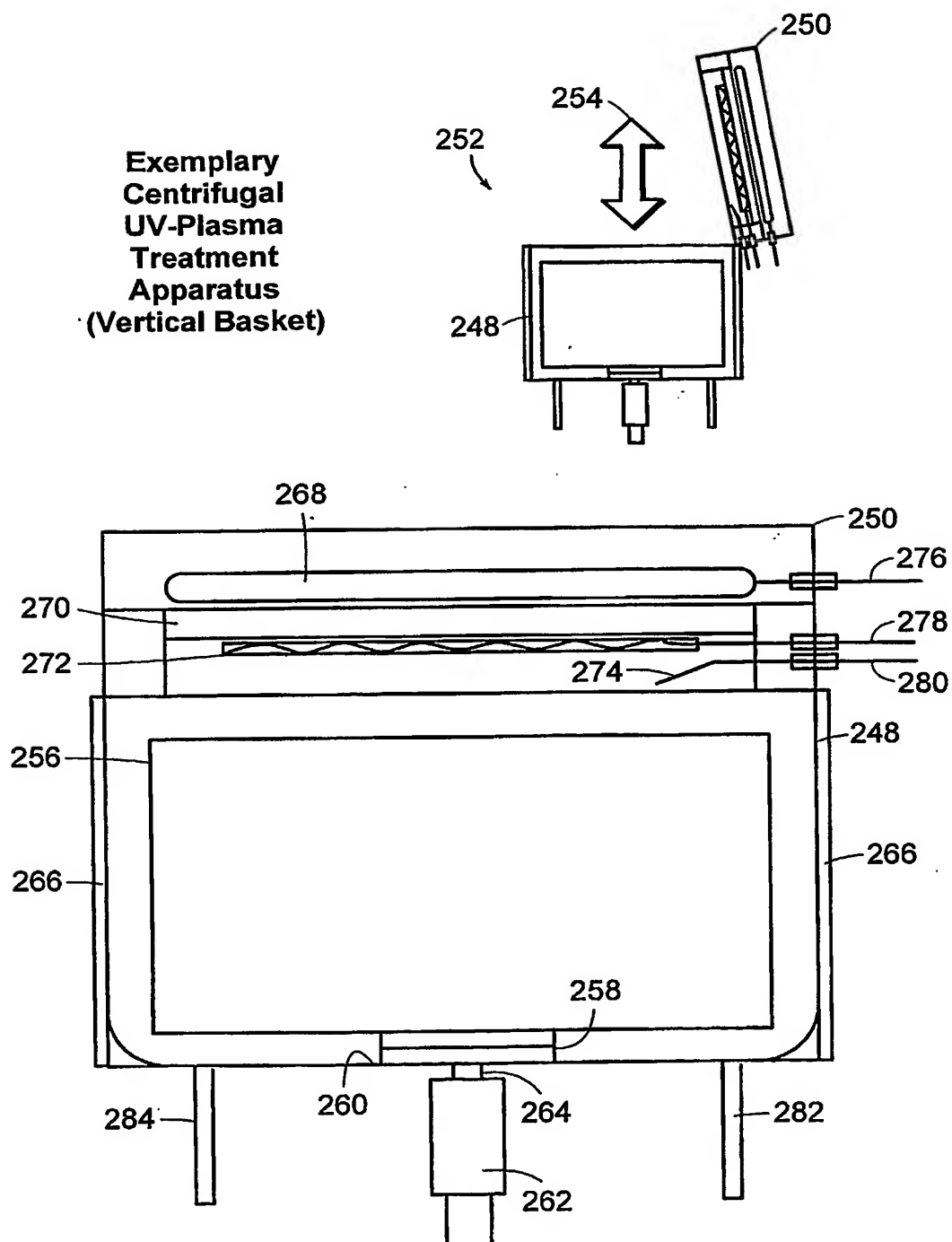


FIG. 16

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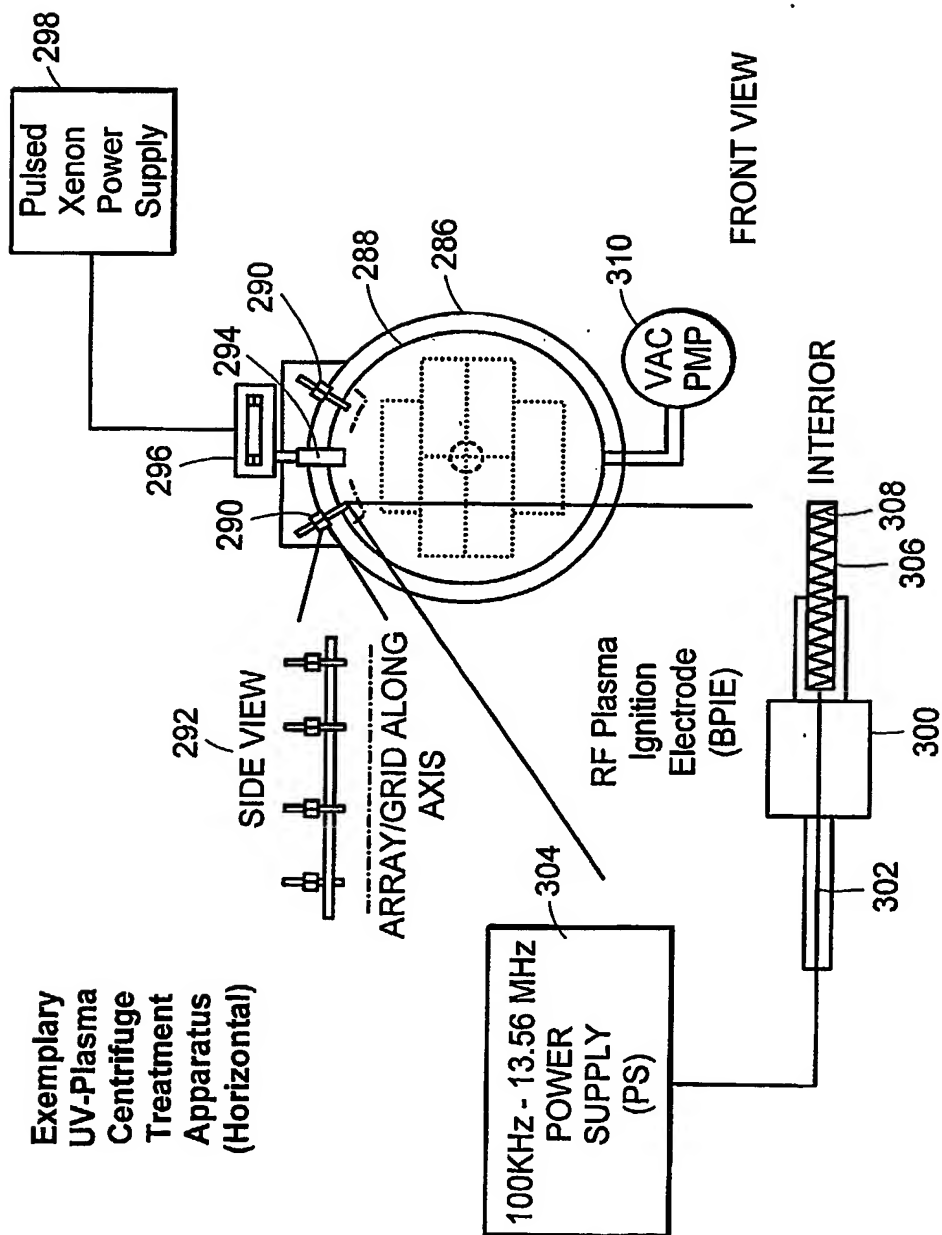
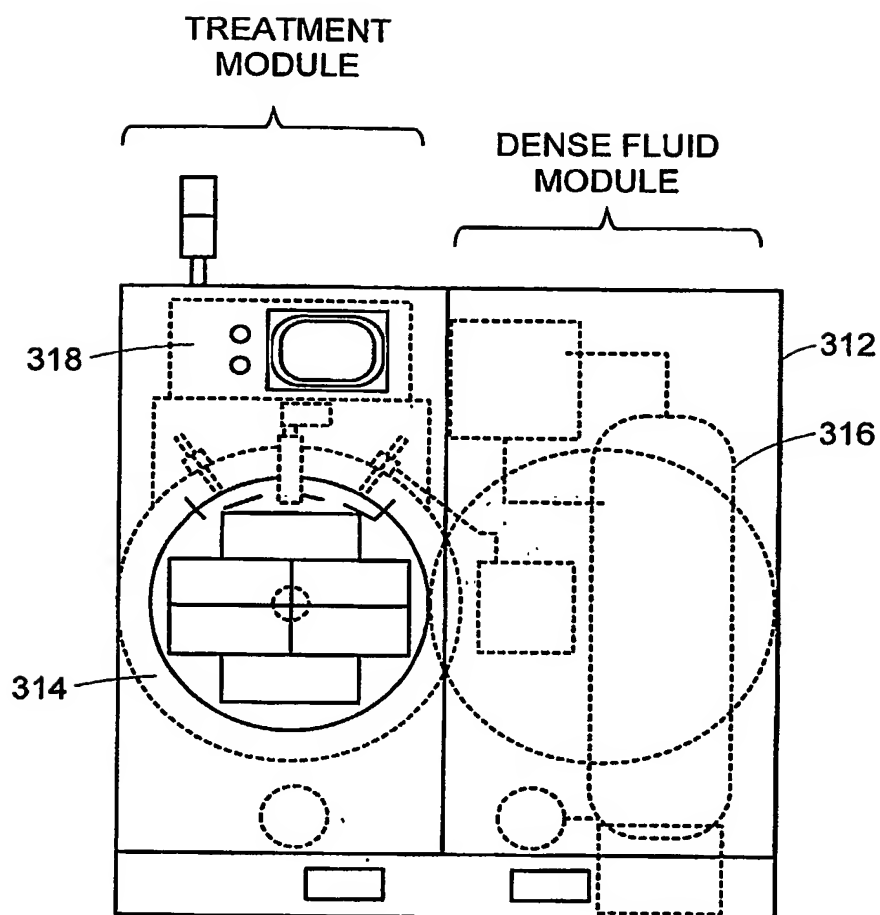


FIG. 17

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**Exemplary Centrifugal UV-Plasma
Treatment System
Design**

FIG. 18

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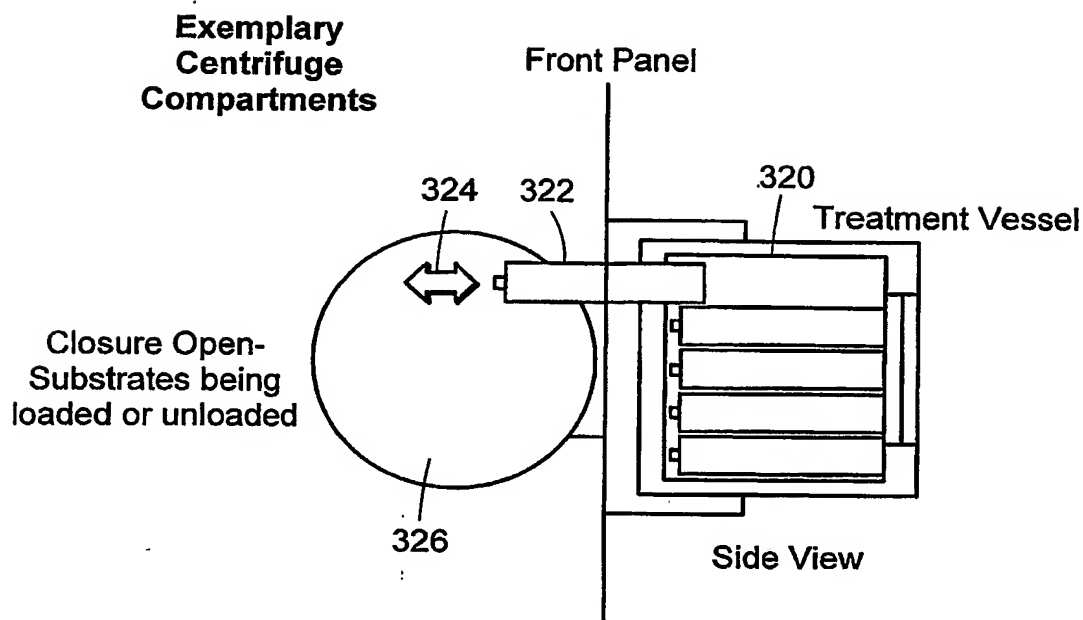


FIG. 19A

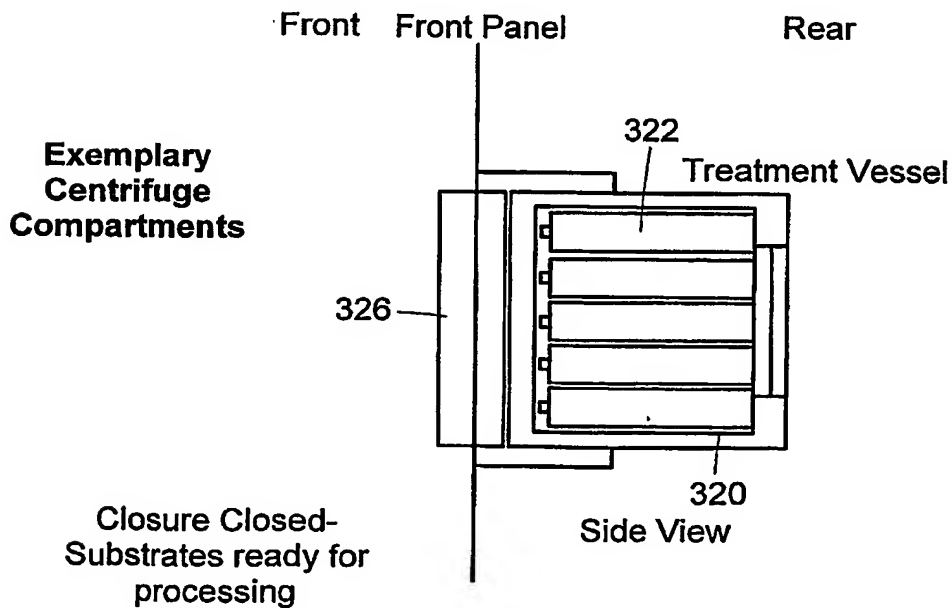
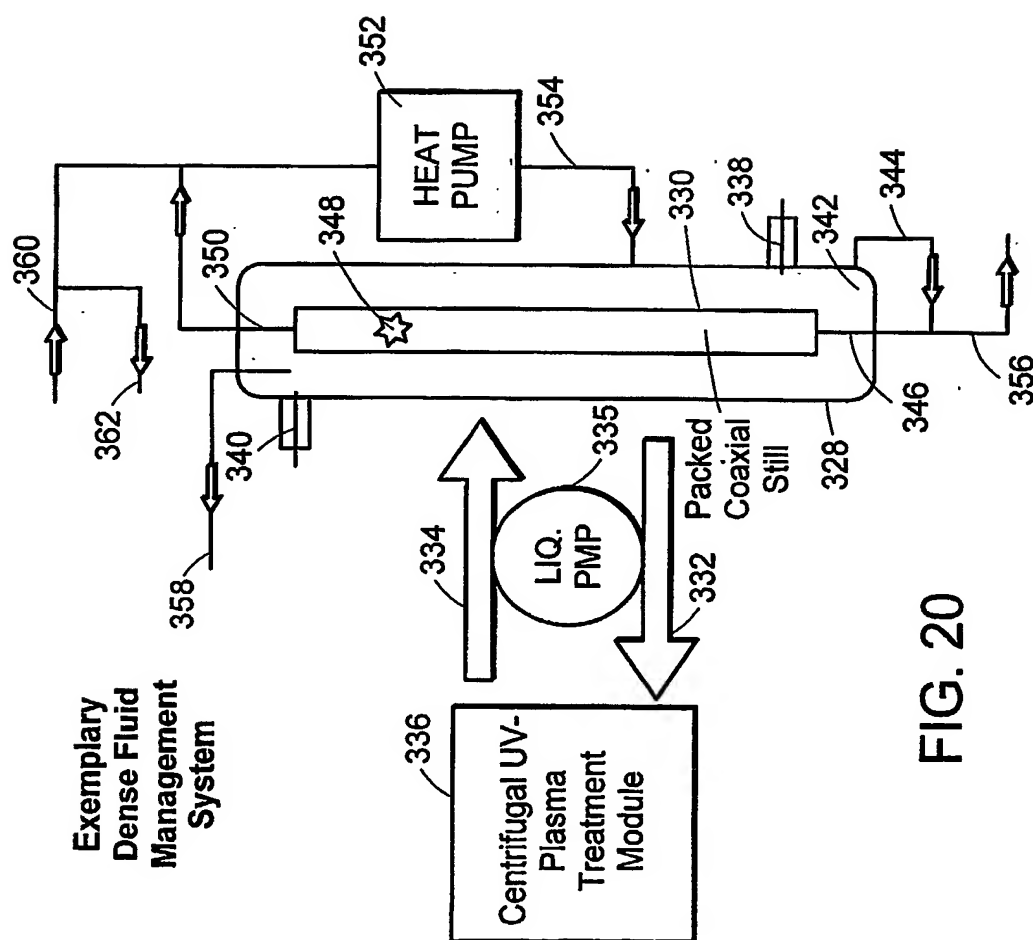
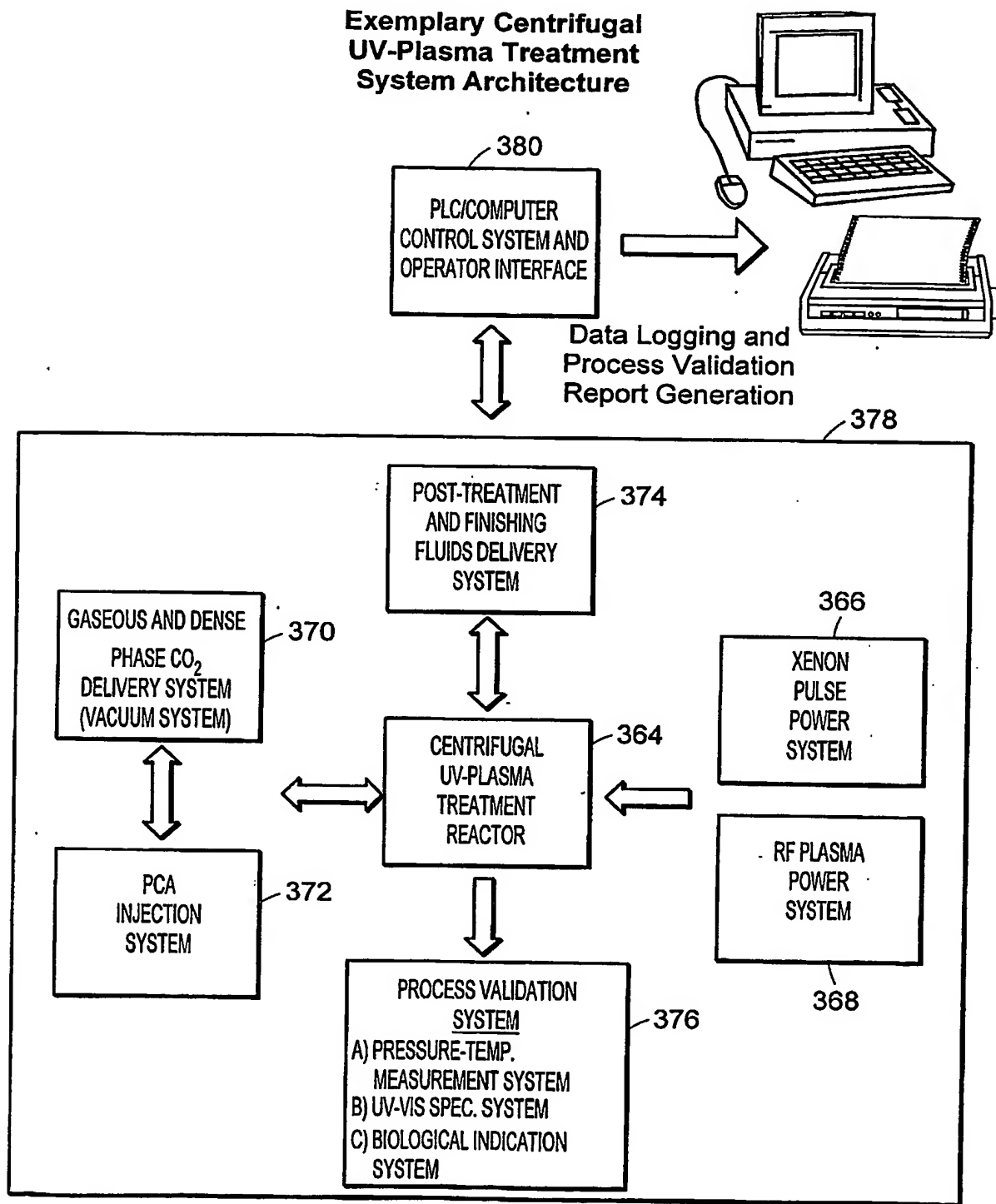


FIG. 19B

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**Exemplary Centrifugal
UV-Plasma Treatment
System Architecture****FIG. 21**

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Treatment Process and Method Embodiments

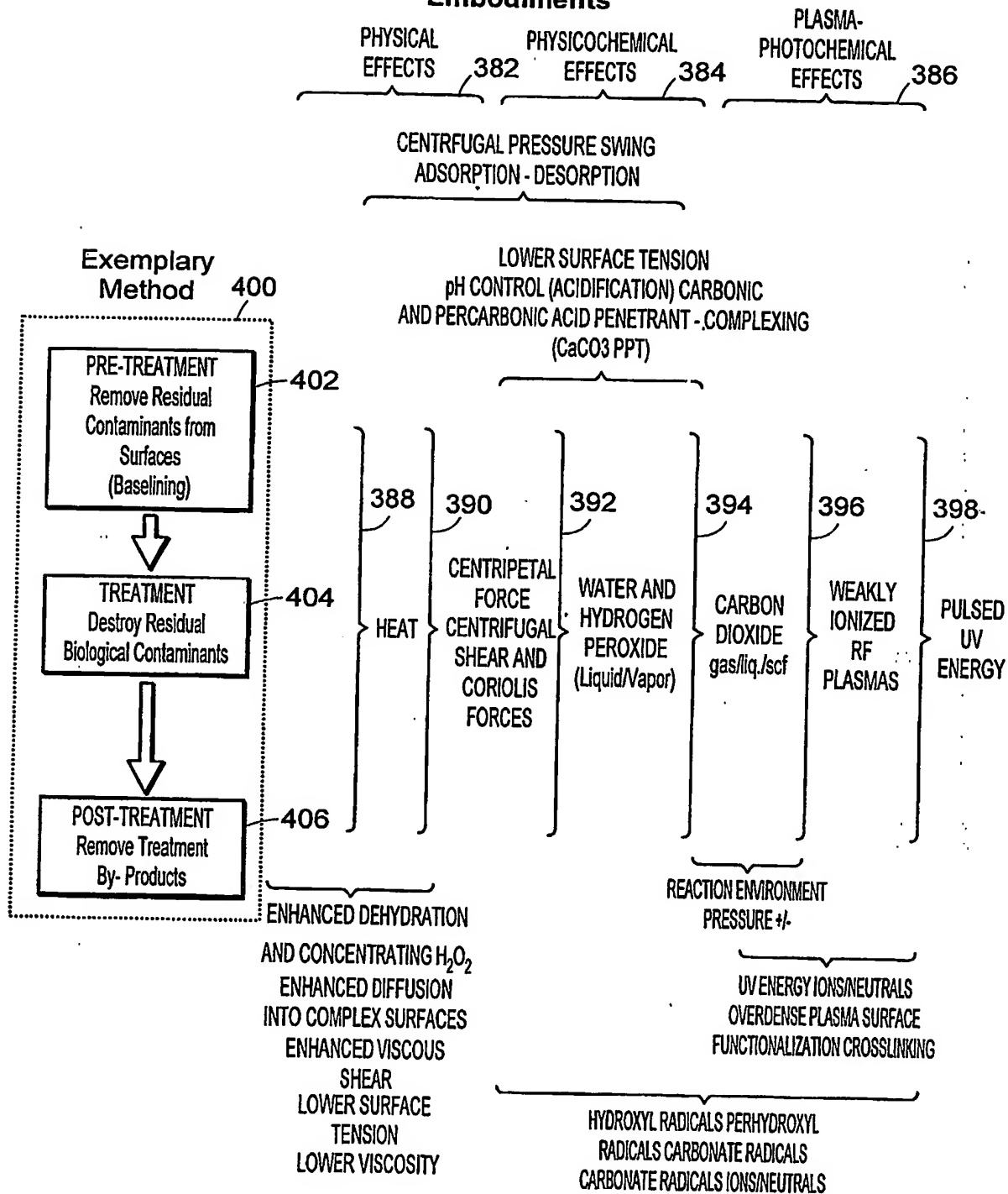
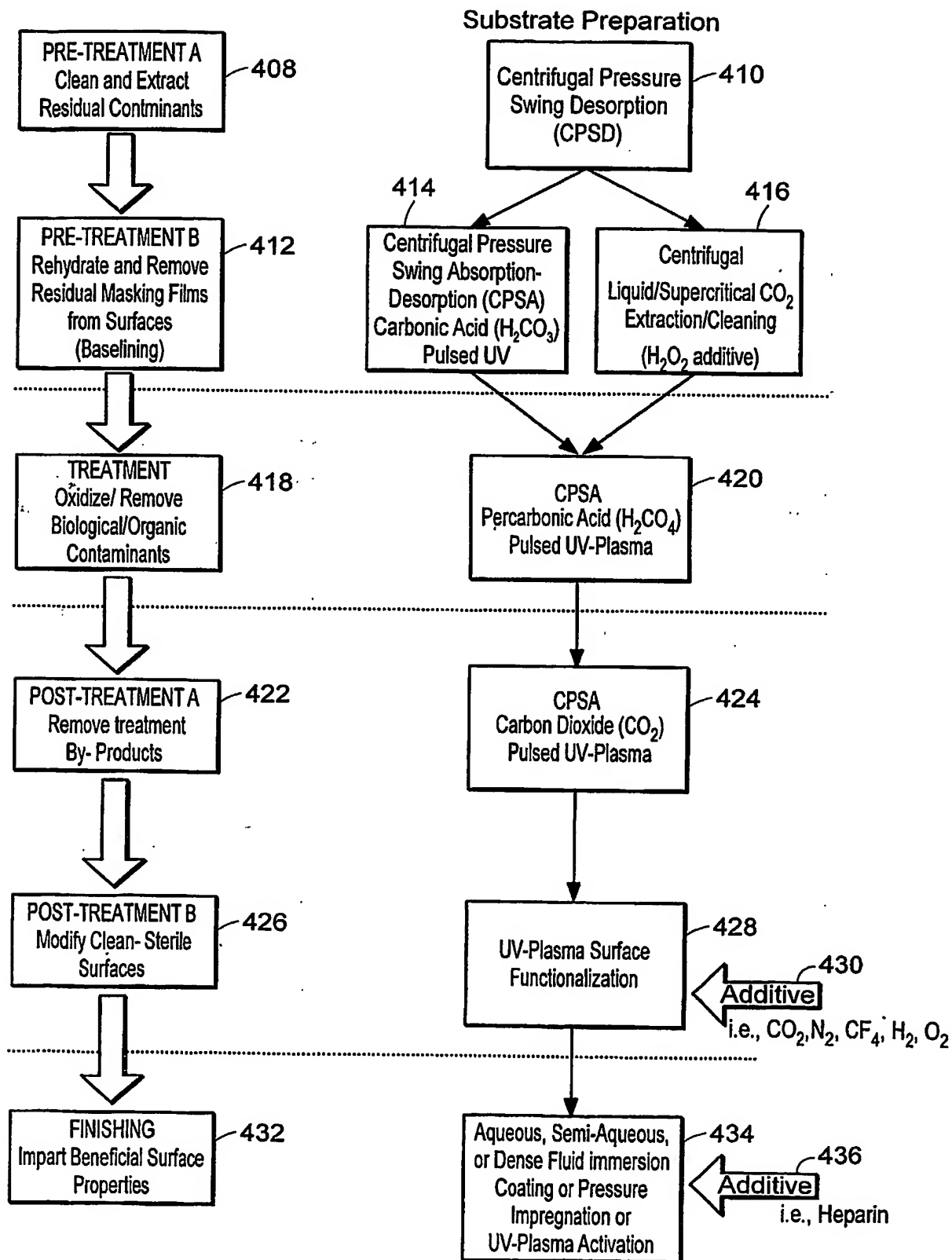


FIG. 22

FIG. 23

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Process and Method
Architecture

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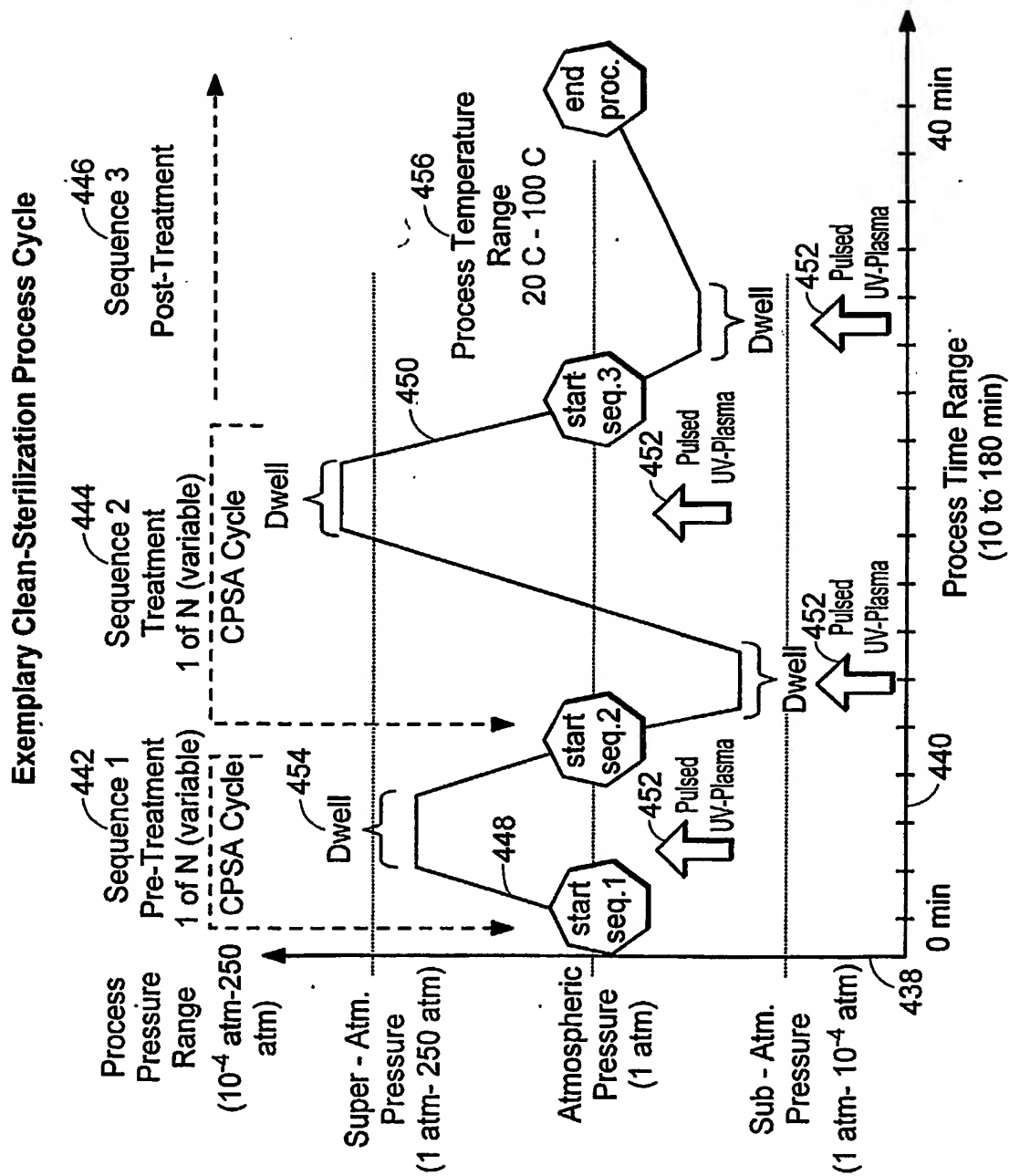


FIG. 24

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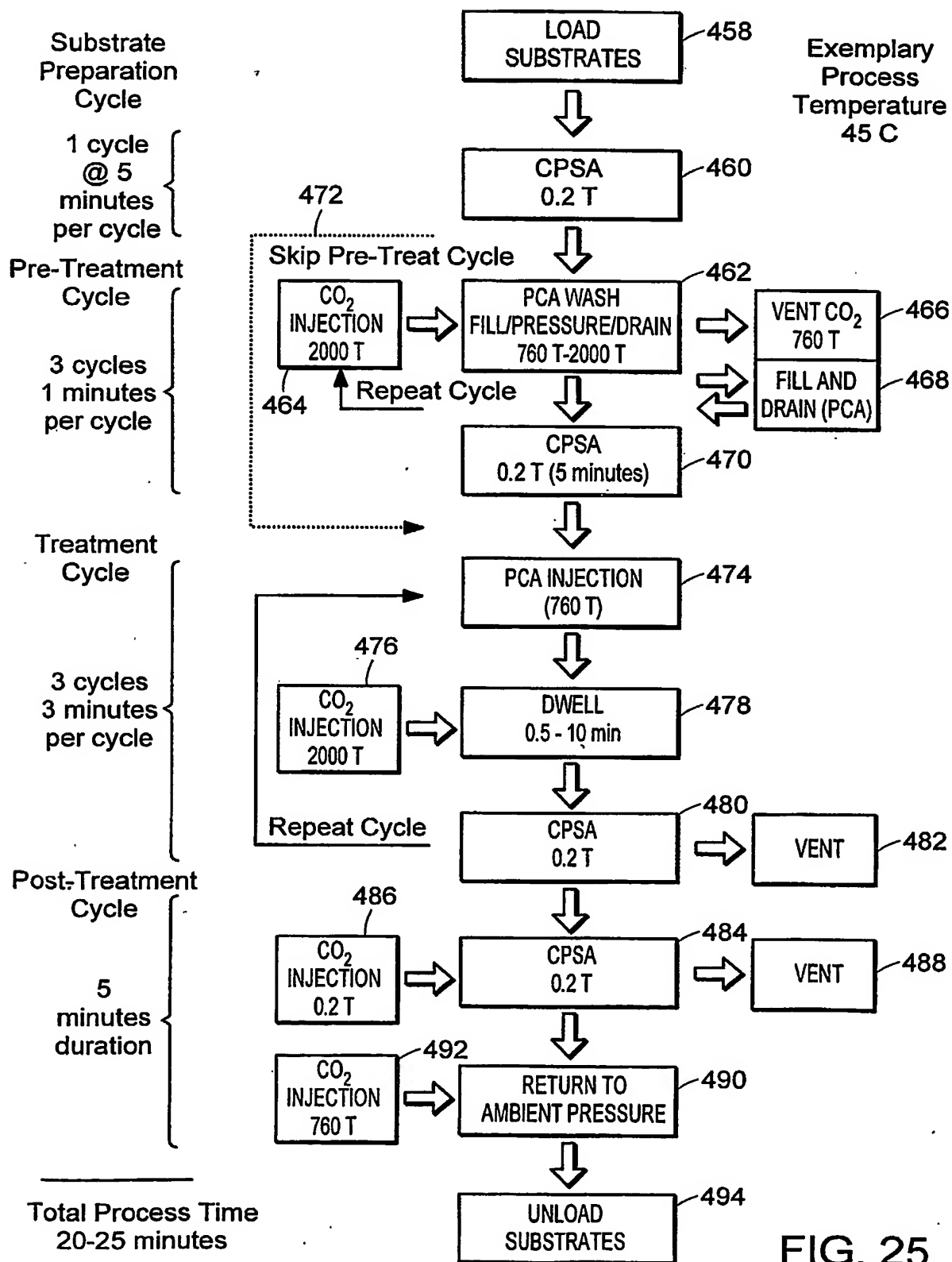
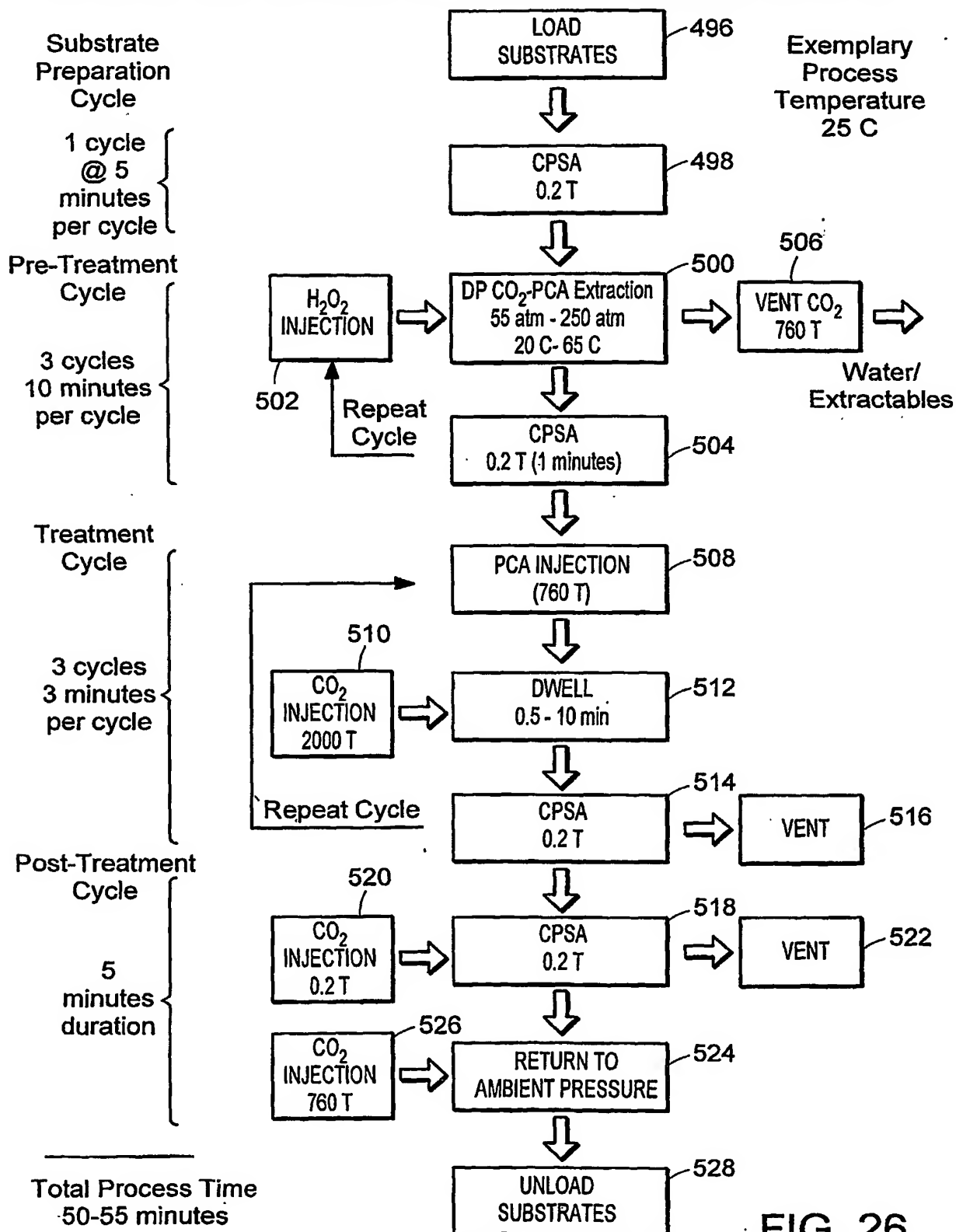
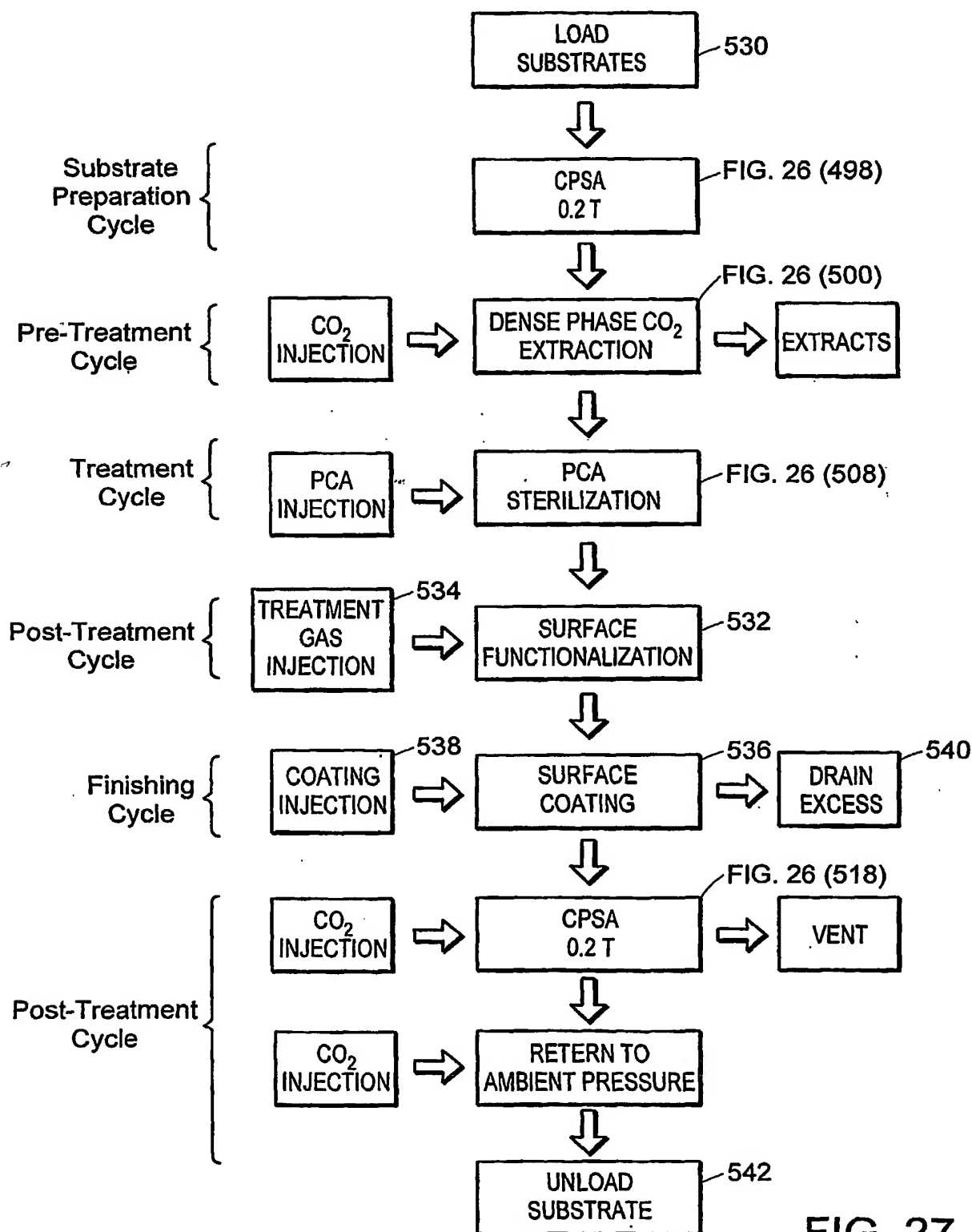
Exemplary Clean-Sterilization Method (Aqueous PCA Wash)

FIG. 25

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Exemplary Clean-Sterilization Method (Dense Phase CO₂ Extraction)**FIG. 26**

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Exemplary Clean-Sterilization Coating Method (Dense Phase CO₂ Extraction)**FIG. 27**

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**Exemplary
Dense Fluid
Extraction Profile**

Typical TML (Total Mass Loss) Profile

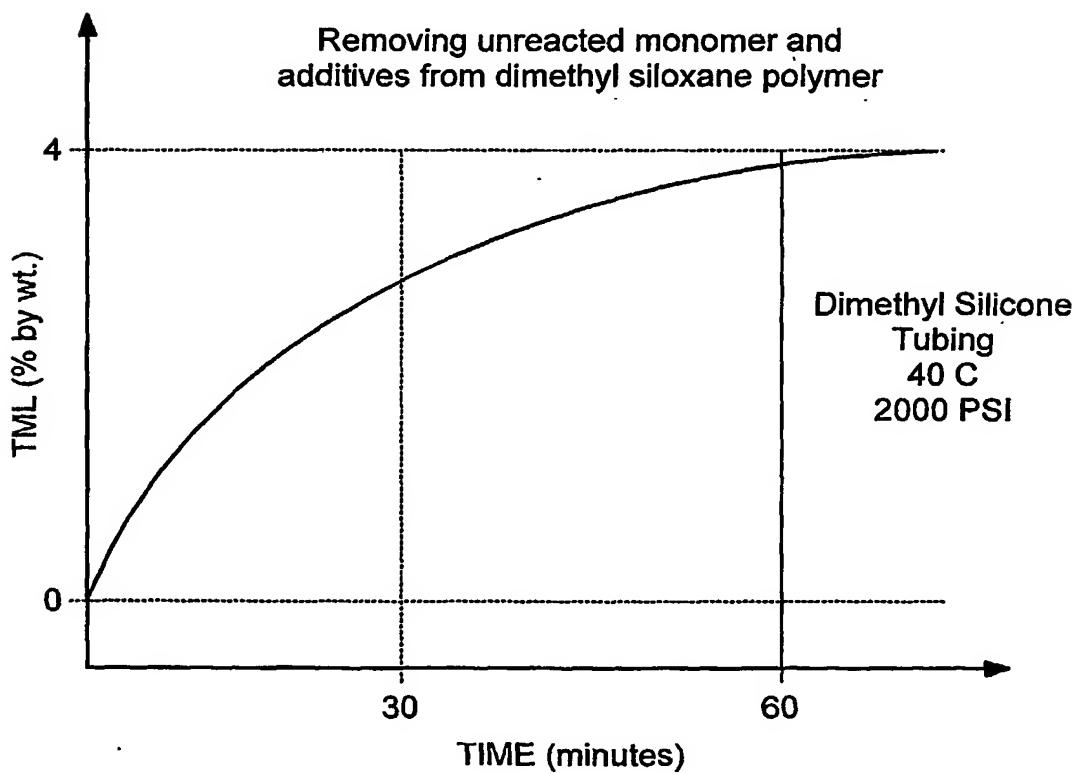


FIG. 28

UV-VIS Spectrophotometric Process-System Analysis System

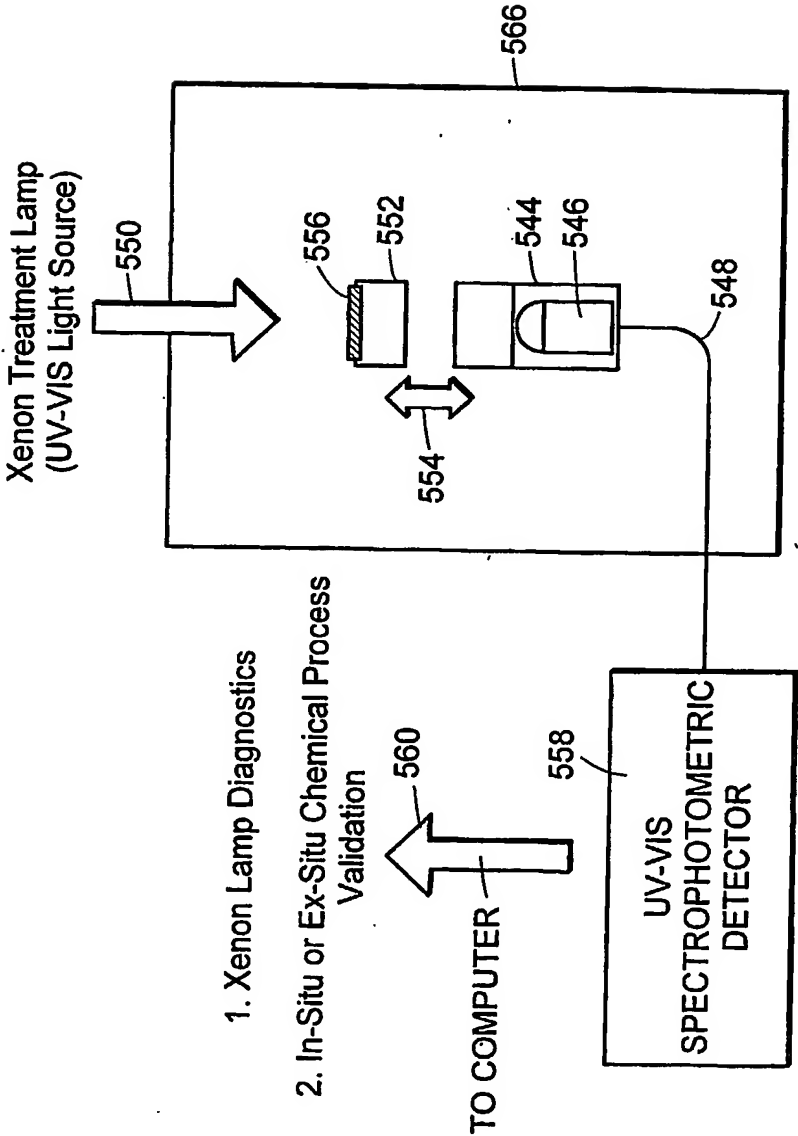


FIG. 29A

UV-VIS Cleaning, Sterilization, and Coating Indicator

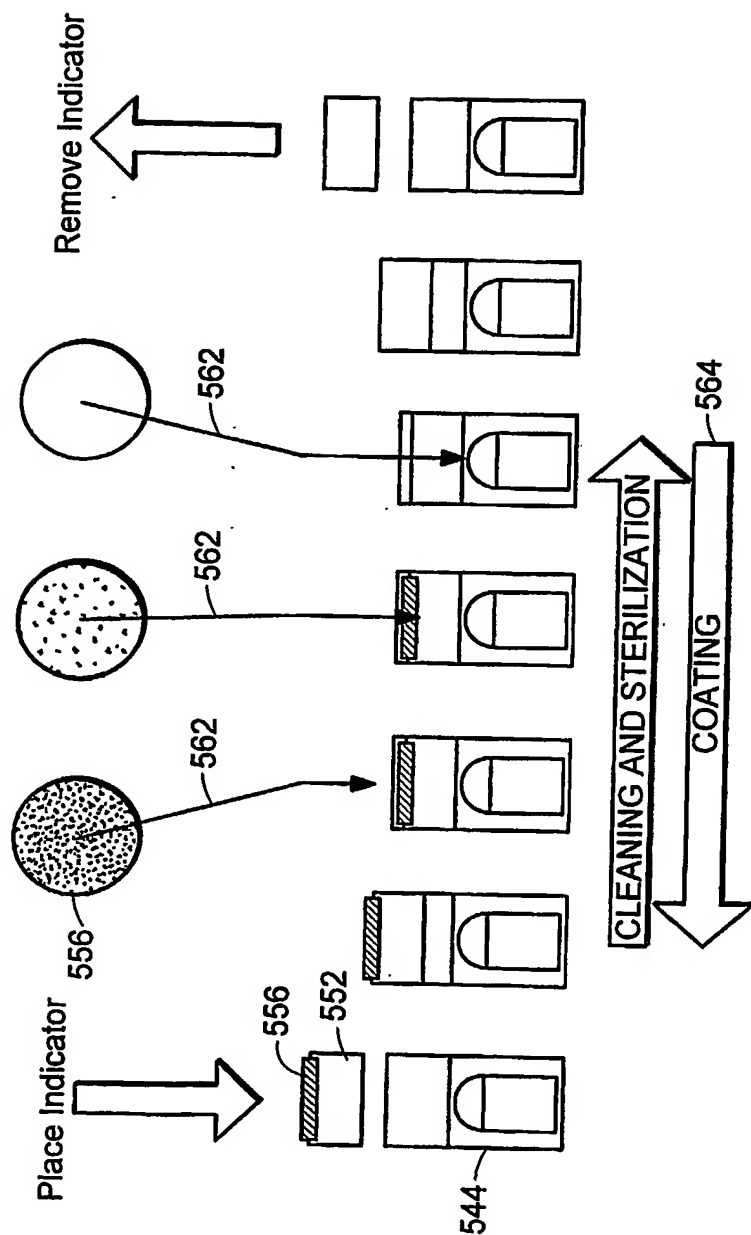


FIG. 29B

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Test Apparatus for Complex Devices

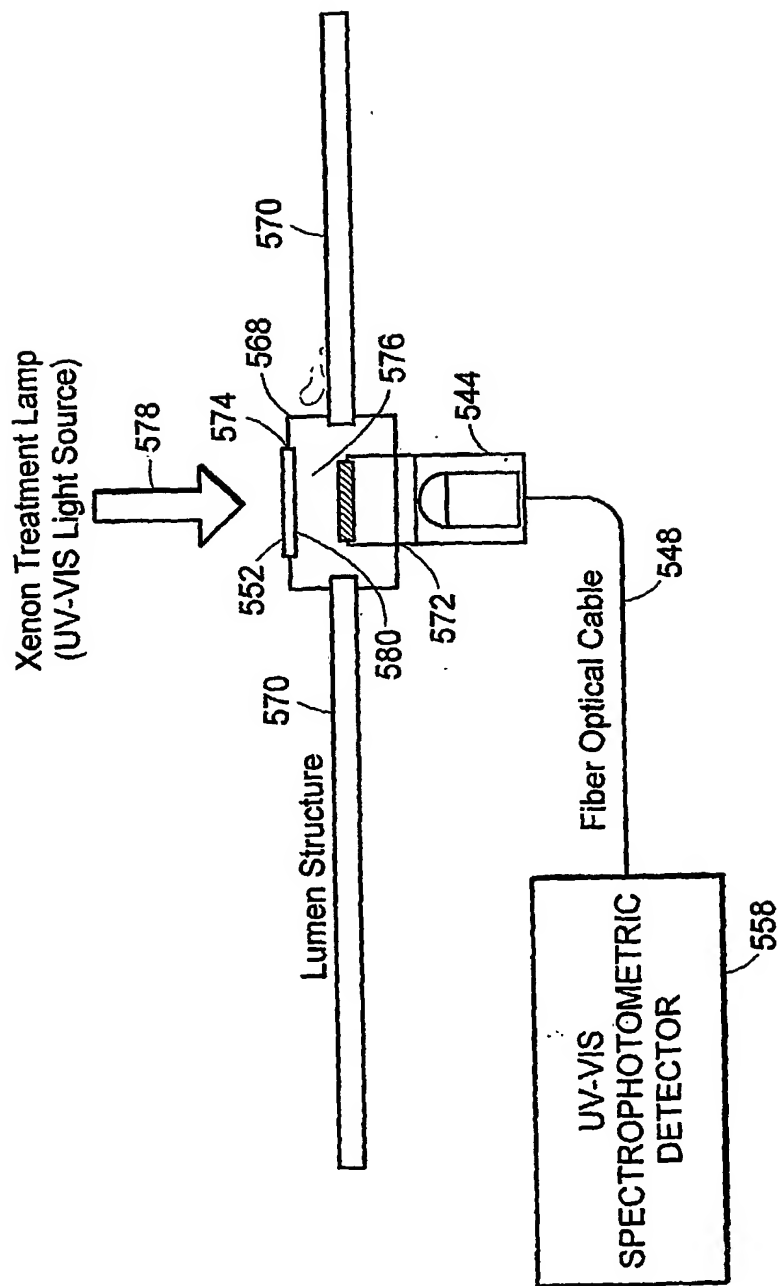


FIG. 30